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Efficiency and Managerial Performance in FBS College Football: To the Employment and Succession Decisions, Which Matters the Most, Coaching or Recruiting?

Joel G. Maxcy[1]

Abstract

This article develops a model of managerial efficiency for National Collegiate Athletic Association's top division college football coaches. The derived efficiency measures are then linked to the hiring and firing process. The work concludes with an evaluation of the effect of head coach succession on team performance. This study evaluates coaching efficiency in terms of both use of talent and recruiting talent. The constructed efficiency rankings are used to evaluate hiring and firing decisions and determine the degree that each type of efficiency plays in these decisions. Last, the efficiency of the market is assessed by evaluating whether universities are making a good choice and are able on average to improve performance when replacing an underperforming coach. The empirical results indicate that both constructs of efficiency matter. Coaches who exhibit high level of both types of efficiencies regularly move up to the most lucrative jobs. Replacement of poor performing coach is most often a wise decision.

Keywords

coaching, football, managerial efficiency, college sports

[1] Temple University, Philadelphia, PA, USA

Corresponding Author:
Joel G. Maxcy, Temple University, Philadelphia, PA 19122, USA.
Email: jmax@temple.edu

Introduction

Nearly 20% of the 120 head coaching positions at college football's highest level, the National Collegiate Athletic Association's (NCAA) Football Bowl Subdivision (FBS), are turned over each year. Highly effective coaches receive lucrative offers from programs seeking to improve their records, and those coaches who fail to meet the performance expectations of their employers are summarily dismissed. The incentive to win is great, as revenues generated by FBS college football programs are large and growing; it is common for the university's football program to generate more revenue than all other varsity sports combined.[1] Winning programs help fill stadiums, and the publicity benefits of increased TV exposure accrue to the university as a whole; thus, the value extracted from success in football is substantial. The rents, which amass to the head coach, are considerable and augmented because market and compensation for the amateur players' services are severely constrained.

The FBS subdivision is segregated into two levels of conference membership. Approximately half of all the FBS members belong to high-resource conferences, where each school shares very lucrative television broadcast rights contracts and are given preferred access to the national championship contest and the major bowls.[2] There are substantial differences in coaches' compensation between the upper and the lower echelons of the FBS. In fact, top-level assistant coaches at the high-resource programs often earn salaries that are considerably higher than head coaches at lower level programs (Berkowitz & Upton, 2011).

The university's hiring decision regarding the head football coach is principal and internal and external hiring are both commonplace. An internal hire is typically a top-level assistant coach, often one who is currently serving as either the defensive or the offensive coordinator. As for external hires, it is common for successful head coaches to move up from a lower level FBS program to take charge of a high-resource program. External hires are sometimes made when a highly regarded subordinate is poached from another program and occasionally a National Football League (NFL) assistant coach will leave the professional ranks for a collegiate head coaching position.[3] There is also mobility within the high-resource group, as very successful coaches are sometimes able to move from their current job to an even higher resource program.[4] The coaches' market is highly competitive because the rents attributed, and compensation paid, to the head coach positions at these schools are substantial—the head football coach is routinely the highest paid employee at his university.

The university's decision to dismiss a current head coach is likewise substantial, much like the decision to remove a chief executive officer (CEO) by their corporate counterparts. As is the case with a CEO, the head coach is responsible for team performance and is an agent of the stockholders/stakeholders who are the direct beneficiaries of that performance. Fama (1980) clarifies the principal–agent problem of accountability in this context. Firm choices in regard to succession are derived from the inherent incentive issues tangled in these relationships. Firm-initiated succession is motivated by the holders' desire to improve performance. Yield may be improved if the successor makes more efficient use of existing resources, if he can augment the current level of resources, or both.

Because data are often sparse, empirical evidence on executive succession in the corporate world, as to its effect on firm performance, is ambiguous. Succession analysis has been extended to professional team sport coaches or managers, where the performance data are quite extensive and facilitates empirical tests that are difficult in standard executive contexts. Coaching efficiency and succession in college sports has received attention. For example, Clement and McCormick (1989) analyzed the efficiency of NCAA basketball coaches regarding the choices made regarding the allocation of playing time. Fizel and D'Itri (1997, 1999) assess the efficiency of talent use and its role in coaches' succession in NCAA basketball. Soebbing and Washington (2011) study the succession of coaches in NCAA football. The college head football coach, like a corporate CEO, is responsible for hiring, maintaining, and overseeing a relatively large staff of assistants, many of whom are delegated responsibility for some part of input procurement (recruiting) and production (game preparation and strategy). The structure of the football team much resembles the hierarchical organizational chart of a midsize corporation.

Following the example of Fizel and D'Itri's (1999) work on NCAA basketball coaches, this article develops a model of managerial efficiency for college football coaches, links those derived efficiency measures to the hiring and firing process, and concludes with an evaluation of the effect of succession on team performance. Winning is presumed a function of efficiency along two fronts, each representing a problem of constrained optimization. First, the coach must gather the appropriate resources, assemble a staff and recruit talented players subject to the means available to him as provided by his employer and the rules determined by the NCAA. Second, the coach must develop, employ, and organize the on-hand talent that he or his predecessor has recruited and produce wins against the predetermined schedule of games. This study is unique in that it evaluates coaching efficiency on both fronts and then constructs a year-by-year rank order of all FBS coaches for each measure. The constructed efficiency rankings are used in conjunction with other human capital and performance measures to evaluate hiring and firing decisions and determine the degree that each type of efficiency plays in these decisions. The efficiency of the market is further assessed by evaluating whether universities are making a good choice that on average improves performance when replacing an underperforming coach. The empirical results indicate that both constructs of efficiency matter. Improvement by the new coach in his first year(s)on the job over a fired coach's just past season is a consistent finding. We also find evidence that he who can win with the other guy's talent will be more likely to continue through with a successful term as head coach. Interestingly, recruiting efficiency tends to improve directly at hire and then decline over time. That decline predicts an eventual firing. Likewise coaches who exhibit high levels of both types of efficiencies often move to the most lucrative jobs.

Method

Efficiency of both input use and input assemblage is estimated using a parametrically estimated efficiency frontier. The process is comparable to the nonparametric Data Envelope Analysis process used by Fizel and D'Itri (1999). Head coaches are evaluated for each of the 120 universities competing at NCAA college football's highest level, the FBS, over a 10-year period comprising the 2002–2011 championship seasons. A coach's performance is assumed to be a direct function of his team's wins in a given season. However, simple win percentage is too simplistic for this evaluation, as team schedules vary considerably in terms of the quality of opponents. To adjust winning to schedule strength the simple rating system (SRS) is utilized to construct an annual rank order of all FBS teams for each season included in the sample. The SRS is a computer-generated metric reported by *Sports Reference.com* (2012), which accounts for each team's strength of schedule and margin of victory. The SRS method compiles a matrix based on all game results so that the full set of teams are rated by their adjusted margin of victory, which is then weighted by their opponents' strength.[5] From these ratings, all FBS teams can be ranked on an ordinal basis each year. The SRS is more exact than other computer ranking methods, including that used to construct the championship and bowl game matchups, which by rule exclude information as they do not permit the use of margin of victory.

Efficiency measures for both recruiting and utilization of talent are formed using the ratio of the coach's measured performance in each category to the constructed efficiency frontier. Talent level is derived from a weighted ranking of each of the four prior recruiting classes as evaluated by *Rivals* (2012), which has provided an annual rank order for each of the FBS team's incoming recruits every year since 2002. An autoregressive process is used to calculate the weights based on the average effect from past years' recruiting classes rank to the current year's performance rank. From the regression coefficients the efficiency frontier is constructed, from which coaches are compared, to see who are getting the most production from their talent input. Briefly, a negative binomial, fixed-effects regression is used to calculate each observation's predicted SRS based on the available talent and by other individual characteristics expected to influence the coach's performance. A ratio of output (SRS rank) predicted by the team's talent level to the actual SRS rank is then constructed, and the ranking of coaches based on that efficiency measure is constructed for each year. Likewise, a similar measure of recruiting efficiency is calculated with annual recruiting class rank employed as the dependent variable. Both the efficiency variables are then included in a survival model to evaluate the determinants of the decision to replace a coach, and likewise to determine the characteristics of coaches chosen to move up to better jobs. Last, we evaluate the effects of the universities' choice of head coach succession on their football team's subsequent SRS rankings.

Data

The data set is a panel consisting of 1,186 coaching-year observations ($C_{k,\ s,\ t}$, coach k, at university s, in year t) representing all of the now 120 FBS schools for each season of its classification in the FBS subdivision of NCAA football, from 2002 to 2011. The initial 478 coach-year observations from 2002 to 2005 are necessary to calculate the talent use efficiency rankings for 2006-2011, so complete data, which included the full set of the calculated talent-use efficiency variables, are available for the 706 observations that cover only the last 6 years. The recruiting efficiency ranking calculations rely on only 1 year of lagged data and are calculated from 2004 to 2011, for a total of 952 coach-year observations. From 2002 to 2011, the number of FBS schools increased gradually from 109 to the current 120 members. Neither of the two subgroups nor the full sample of 1,186 coach-year observations is exactly divisible by 120. Human capital measures and proxies, team performance statistics, and demographic variables for each coaching-year observation are included in the data.

The Input Use Model

The head coach is the agent ultimately responsible for the production of output (wins) from the available inputs. For stage one, the inputs are taken as being the given level of talent available to the head coach and his staff each season. Talent level can be quantified as a measure of the quality of the successive recruiting classes of incoming high school players who comprise the rosters of each team. Scouting services, which have proliferated in the Internet age and include the most prominent, *Scouts* (*Fox Sports*) and *Rivals* (*Yahoo*), compute rankings of each football program's recruiting class quality as a weighted summation of the quality level assigned to each individual recruit. The *Rivals* rankings are used here because they have published a rank order for the full set of FBS teams since 2002.[6] With few exceptions, incoming players are eligible to remain on the roster for 5 years, so the level of talent for a given season is a function of the quality of the five most recent recruiting classes. Although an incoming player may stay on the roster for 5 years, the very best players often leave and move on to professional football after 3 years, so we might expect the latest recruiting classes to have more impact on current wins than earlier ones. A team's productive output (SRS rank) in any given year is a function of the cumulative talent available to the coach, the coaching input, and the resources provided to the coach by his employer. The coaching input includes standard human capital assets and can also be adjusted to reflect the degree to which the coach is using his own inputs or those collected by his predecessor so that

$$\mathrm{SRS}_{ist} = f\left(\sum_{t=-4}^{0} T_i, \mathbf{Y}_s, \mathbf{C}_{kt}, \mathbf{X}_{kt}\right), \qquad (1)$$

where T represents the cumulative level of talent; $\mathbf{Y}$ is a vector of the university's football program specific resources and characteristics; $\mathbf{C}$ is a vector of variables representing the coach's human capital attributes as of year t; and **X** is a vector of variables that define the coach's level of involvement in the collection of his team's level of talent T.

Efficiency in this context is defined as making the best use of the available inputs and is measured as a comparison between a given coach/manager and those who are the most efficient in the sample. This method is a widely accepted process for estimating managerial efficiency. Fizel and D'Itri (1999) provide a thorough review of this literature and its extension to coaching, and the reader is referred to their excellent work. In this case, the coach is asked to produce wins from the talent currently presented to him. The analysis constructs an efficiency frontier so that each specific coach-year observation to be compared to all other coach-year observations in the sample. Ratios are calculated to determine the degree to which a given coach makes better or worse use of talent relative to the most efficient use as determined by the remainder of group. The frontier is determined by the following regression equation.

$$\begin{aligned}\text{SRSRank}_{it} = \beta_0 &+ \text{CLASSRANK}_{it} + \beta_1\text{CLASSRANK}_{it-1} + \beta_2\text{CLASSRANK}_{it-2} \\ &+ \beta_3\text{CLASSRANK}_{it-3} + \beta_4\text{CLASSRANK}_{it-4} + \beta_5\text{AGE}_{kt} \\ &+ \beta_6\text{ADVDEGREE}_{kt} + \beta_7\text{RACE}_{kt} + \beta_8\text{REPFIRED}_t \\ &+ \beta_9\text{REPFIRED}_{t-1} + \beta_{10}\text{REPFIRED}_{t-2} + \beta_{11}\text{REPRETIRED}_t \\ &+ \beta_{12}\text{REPRETIRED}_{t-1} + \beta_{13}\text{REPRETIRED}_{t-2} + \beta_{14}\text{REPMOVED}_t \\ &+ \beta_{15}\text{REPMOVED}_t + \beta_{16}\text{REPMOVED}_t + e_{it}.\end{aligned}$$

CLASSRANK is the *Rivals* ranking for each of team i's previous five recruiting classes comprising the year t roster. AGE is the chronological age during year t of the kth coach. ADVDEGREE is an indicator variable coded 1 if the kth coach has earned by year t a college degree beyond the bachelor's level. RACE is an indicator variable coded 1 for non-White coaches. The data set includes one entry for the coach of each of the FBS teams from 2002 to 2011. The remaining variables indicate term and specifically whether the kth coach is in his first, second, or third year with his team i. In each such case, the coach utilizes some talent accumulated by his predecessor.[7] The variables distinguish whether the new coach replaced one who was fired (REPFIRED), had retired (REPRETTIRED), or had moved on to a better position (REPMOVED).

A negative binomial regression employing fixed effects to account for program-specific variance at the individual university level is applied to determine the coefficients that are used to construct the efficiency frontier. Table 1 reports the summary statistics and the regression coefficients are reported in Table 2. One can see that on average the current year's recruiting class is most important, but that the third and fourth year's classes both carry more weight than the second. This suggests that incoming players either have an immediate impact on team success or develop later so as to contribute further along in their college careers. Fifth year seniors, many of whom could be presumed to have left the program by then, have the

Table 1. Summary Statistics.

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
BCS	1,186	0.55	0.50	0	1
$CLASSRANK_t$	1,173	59.14	33.91	1	120
$CLASSRANK_{t-1}$	1,056	59.01	33.85	1	120
$CLASSRANK_{t-2}$	939	58.79	33.81	1	120
$CLASSRANK_{t-3}$	822	58.50	33.70	1	120
$CLASSRANK_{t-4}$	705	58.14	33.57	1	120
AGE	1,186	51.22	8.35	32	85
ADVDEGREE	1,186	0.41	0.49	0	1
RACE	1,186	0.08	0.27	0	1
FIRED	1,186	0.11	0.32	0	1
MOVED	1,186	0.04	0.19	0	1
RETIRED	1,186	0.01	0.12	0	1
TERM	1,186	5.41	5.59	0.00	46
SRS RANK	1,186	59.81	34.26	1	120
SRS $RANK_{t-1}$	1,069	59.73	34.25	1	120
DSRS RANK	1,069	0.17	24.08	−80	86
W-L %	1,186	0.51	0.22	0%	100%
CONFERENCE W-L %	1,150	0.50	0.26	0%	100%
TALENT USE EFFCIENCY	706	1.73	2.95	0.11	47.02
RECRUITING EFFICIENCY	952	2.12	3.39	0.25	48.82

Note. SRS = simple ranking system.

smallest effect but remain a significant determinant of success. These results are generally consistent with Herda et al. (2009) who found that the correlation with a prominent computer ranking system (Sagarin) and both Scouts and Rivals recruiting class rankings was greatest in the first year and declined with each successive class. In regard to the use of a predecessor's talent, it can be seen that the replacement for a retired or fired coach performs worse than average but only in the first year of the new regime. From the second year forward, there is no statistically significant effect from using talent collected by the former coach. This is logical, as the new coach will likely quickly weed out holdovers that do not fit well with his new system.

The regression coefficients are then used to construct the coaches' efficiency rankings for each coach-year observation for which a full set of five recruiting years is available (all years from 2006-2011 except for cases where the university entered the FBS after 2002). As explained by Fizel and D'Itri (1999), a set of k linear programs is developed to compare how each coach uses his available talent resources relative to the set of peers in the sample. A ratio of each coach k's SRS rank in each year t to the efficient SRS rank is calculated for each coach. Table 3 reports the top and bottom 10 coaches in talent use efficiency and their corresponding SRS rank for each year, 2006-2011.[8]

Table 2. Determinants of Talent Use Efficiency.

	Dependent Variable: SRS RANK			
Observations	705		705	
Groups	120		120	
Variable	Coefficient	z	Coefficient	z
CONSTANT	0.280	1.28	0.592*	5.14
$CLASSRANK_t$	0.006*	4.87	0.003*	4.84
$CLASSRANK_{t-1}$	0.003*	2.24	0.003*	2.74
$CLASSRANK_{t-2}$	0.004*	3.68	0.004*	3.55
$CLASSRANK_{t-3}$	0.004*	3.57	0.004*	3.58
$CLASSRANK_{t-4}$	0.002**	2.04	0.002**	2.06
AGE	0.005	1.56		
ADVDEGREE	0.052	0.98		
RACE	0.027	0.36		
$REPFIRED_t$	0.095	1.72***		
$REPFIRED_{t-1}$	0.068	1.25		
$REPFIRED_{t-2}$	−0.016	−0.31		
$REPRETIRED_t$	0.259	2.21**		
$REPRETIRED_{t-1}$	0.201	0.95		
$REPRETIRED_{t-2}$	0.064	0.3		
$REPMOVED_t$	−0.008	−0.09		
$REPMOVED_{t-1}$	0.132	1.51		
$REPMOVED_{t-2}$	−0.047	−0.44		
		$p > \chi^2$		$p > \chi^2$
Log likelihood	−2,503.73*	.00	−2,510.91*	.00

*Significant at .01. **Significant at .05. ***Significant at .1.

The rankings reveal some observations of interest. Generally, coaches from high-resource (BCS) programs populate both the top and the bottom of the efficiency rankings. The correlation between the top 10 rankings in efficiency with the top 10 SRS ranks is reasonably high. Coaches from BCS programs, who use their talent efficiently, also tend to finish high in the SRS rankings. This is a sensible result because superior coaches are likely to rise through the ranks and eventually attain a BCS position. In each year, there are instances of coaches from lower resource schools who also crack the top 10 in talent use efficiency, and generally their SRS rank will be 5 to 10 spots lower than their talent use efficiency rank. BCS coaches are also overrepresented in the bottom 10 rankings, although their corresponding SRS ranking is often much higher. It is noteworthy that most of the coaches appearing more than once in the bottom group have been since fired, especially when they have successive appearances on this list.

Input Assemblage

For the measurement of each coach's input assemblage effectiveness, again the construction of a frontier is used to evaluate efficiency in recruiting such that

Table 3. Coaches Best and Worst Talent Use Efficiency 2009-2011.

	Top 10			Bottom 10			
2009	Ratio	Talent Use Efficiency Rank	SRS Rank		Ratio	Efficiency Rank	SRS Rank
Patterson, TCU	16.502	1	5	Rodriguez, Michigan	0.156	120	70
Saban, Alabama	14.142	2	1	Carroll, Southern California	0.301	119	25
Kelly, Cincinnati	8.797	3	8	Richt, Georgia	0.338	118	26
Beamer, VPI	7.613	4	4	Sherman, Texas A&M	0.387	117	54
Petersen, Boise State	6.596	5	11	Zook, Illinois	0.406	116	80
Meyer, Florida	5.779	6	2	Weis, Notre Dame	0.422	115	38
Kelly, Oregon	5.291	7	6	Friedgen, Maryland	0.431	114	92
Johnson, Georgia Tech	4.002	8	10	Neuheisel, UCLA	0.435	113	50
Brown, Texas	3.496	9	3	Bowden, Florida State	0.444	112	40
Calhoun, Air Force	3.120	10	37	Wulff, Washington State	0.511	111	112
2010							
Harbaugh, Stanford	35.787	1	1	Brown, Texas	0.149	120	57
Petersen, Boise State	19.613	2	4	Rodriguez, Michigan	0.206	119	60
Kelly, Oregon	13.960	3	2	Neuheisel, UCLA	0.280	118	65
Patterson, TCU	13.869	4	6	Kiffin, Southern Califirnia	0.290	117	24
Ault, Nevada	6.284	5	18	Richt, Georgia	0.318	116	39
Chizik, Auburn	4.459	6	3	Dooley, Tennessee	0.357	115	56
Gundy, Oklahoma State	3.493	7	9	Meyer, Florida	0.362	114	26
Bielema, Wisconsin	3.144	8	13	Nutt, Mississippi	0.376	113	69
Calhoun, Air Force	2.954	9	37	Paterno, Penn State	0.408	112	50
Petrino, Arkansas	2.864	10	11	Schiano, Rutgers	0.502	111	91
2011							
Petersen, Boise State	10.721	1	7	Chizik, Auburn	0.256	120	46
Gundy, Oklahoma State	10.648	2	3	Fickell, Ohio State	0.273	119	42

(continued)

Table 3. (continued)

	Top 10			Bottom 10			
2009	Ratio	Talent Use Efficiency Rank	SRS Rank		Ratio	Efficiency Rank	SRS Rank
Saban, Alabama	9.372	3	1	Nutt, Mississippi	0.284	118	95
Shaw, Stanford	5.408	4	6	Neuheisel, UCLA	0.363	117	71
Snyder, Kansas State	4.859	5	17	Dooley, Tennessee	0.383	116	45
Briles, Baylor	4.609	6	12	Muschamp, Florida	0.447	115	34
Bielema, Wisconsin	4.578	7	9	Graham, Pittsburgh	0.477	114	61
Sumlin, Houston	4.424	8	16	Edsall, Maryland	0.491	113	102
Miles, LSU	4.129	9	2	Withers, North Carolina	0.495	112	47
Stoops, Oklahoma	4.065	10	4	Embree, Colorado	0.537	111	103

Note. SRS = simple ranking system.

$$\mathrm{RE}_{it}{=}f\left(\mathrm{PER}_{it-n},\mathbf{C}_{kt},\mathbf{Y}_{s},\right). \quad (2)$$

Recruiting efficiency is a function of program's resources represented by vector **Y**, the *k*th coach's human capital characteristics (vector **C**) and the team's past performance record. The efficiency frontier is determined by the following regression equation.

$$\begin{aligned}\mathrm{CLASSRANK}_{it} = \beta_0 &+ \mathrm{SRSRank}_{it-1}+\beta_1\mathrm{TERM}_{kt}(\mathrm{AGE}_{kt}) + \beta_2\mathrm{ADVDEGREE}_{kt}\\ &+\beta_3\mathrm{RACE}_{kt}+\beta_4\mathrm{REPFIRED}_{t}+\beta_5\mathrm{REPFIRED}_{t-1}\\ &+\beta_6\mathrm{REPFIRED}_{t-2}+\beta_7\mathrm{REPRETIRED}_{t}+\beta_8\mathrm{REPRETIRED}_{t-1}\\ &+\beta_9\mathrm{REPRETIRED}_{t-2}+\beta_{10}\mathrm{REPMOVED}_{t}+\beta_{11}\mathrm{REPMOVED}_{t}\\ &+\beta_{12}\mathrm{REPMOVED}_{t}+e_{it}.\end{aligned}$$

TERM is the number of seasons that the *k*th coach has been employed with his current team in year *t*. It can be substituted for AGE from the previous model and may provide more information as an explanatory variable in this case. Otherwise the variable definitions are the same as those given for Equation 2. Once more the negative binomial regression employing fixed effects is applied to determine the coefficients that are used to construct the efficiency frontier. The regression coefficients are reported in Table 4. In exactly the same manner as the previous method, the coefficients are used to calculate the efficiency frontier, individual ratios for each coach-year observations, and ordinal rankings for each year shown in Table 5. [9]

The regression yields some interesting results. As expected, a successful season improves the upcoming recruiting class. The reasons are twofold; there is likely an advertising effect as good teams merit more and better media attention. For very good teams, more replacements are likely to be needed for the players who have moved on to the professional ranks. Surprisingly, the longer a coach stays on the job, the less efficient a recruiter he becomes; possibly this result is due to the loss of key assistants who become known for their recruiting prowess and move on to better jobs. There is a significant drop off in the first recruiting class for the coach who has replaced either a coach who has moved on or one who was fired. In the case of replacing a coach who has moved on, the negative effect is mitigated by the next year; and in the cases of replacing a fired coach, the negative first-year effect is fully reversed in the second year. The replacing of a retired coach has no discernible effect on recruiting.[10] There may be some inherent flaws to this method, as the rankings routinely show that coaches from high-resource schools coming off poor performance years are efficient recruiters. Likewise, coaches from lower resource schools that have strong performance years are often revealed as the least efficient recruiters. It is likely some of these coaches, Petersen of Boise State and Patterson of TCU for example, are not poor recruiters, but rather they utilize a style of play that does not rely on players who represent standard recruiting service classifications of great talent. Coaches recruit players who good fit their style of play, but by doing so they

Table 4. Determinants of Recruiting Efficiency.

	Dependent Variable: CLASS RANK			
Observations		952		952
Groups		120		120
Variable	Coefficient	z	Coefficient	z
CONSTANT	2.617*	27.48	2.536*	18.38
$SRSRank_{it-1}$	0.003*	6.73	0.003*	6.71
AGE			0.002	1.17
TERM	0.006	1.46		
ADVDEGREE	−0.041	−1.37	−0.040	−1.33
RACE	−0.052	−1.19	−0.044	−0.99
$REPFIRED_t$	0.112*	2.97	0.088*	2.79
$REPFIRED_{t-1}$	−0.132*	−3.49	−0.150*	−4.37
$REPFIRED_{t-2}$	−0.050	−1.48	−0.062	−1.91
$REPRETIRED_t$	0.036	0.45	0.017	0.21
$REPRETIRED_{t-1}$	−0.064	−0.46	−0.069	−0.51
$REPRETIRED_{t-2}$	−0.006	−0.04	−0.011	−0.08
$REPMOVED_t$	0.226*	4.12	0.201*	3.92
$REPMOVED_{t-1}$	−0.080	−1.36	−0.100***	−1.76
$REPMOVED_{t-2}$	0.048	0.84	0.035	0.63
		$p > \chi^2$		$p > \chi^2$
Log likelihood	−3,305.25*	.00	−3,305.61*	.00

*Significant at .01. **Significant at .05. ***Significant at .1.

may not amass highly ranked recruiting classes. Thus, they rank high in talent use efficiency and low in recruiting efficiency.

Determination of the Employment Decision on Succession

A successor is needed either when the coach is fired or when the coach leaves either by retirement or moves to another position. We drop retirement cases from consideration and propose that the coaches' performance motivates both dismissals and quits. Performances that fall below expectations motivate dismissals, while superior performance levels bring about lucrative offers from other potential employers. To empirically evaluate the effects of various aspects of coaching performance, including both efficiency constructs, survival analysis is employed and hazard function models are constructed. The data are right censored and the firing date and quit date for all coaches represented in the data set are not yet determined for some observations. A Weibull distribution model is constructed as follows:

$$h(\mathbf{X},t) = \alpha t^{\alpha-1} e^{\beta X}, \tag{3}$$

where t is the elapsed duration of the coaches current term of employment, and $\mathbf{X}$ is a vector of independent variables that effect the succession decision. Two models are

Table 5. Coaches' Best and Worst Recruiting Efficiency 2009-2011.

	Top 10			Bottom 10			
2009	Ratio	Recruiting Efficiency	Ex ante SRS		Ratio	Recruiting Efficiency	Ex ante SRS
Tressel, Ohio State	22.43	1	8	Whittingham, Utah	0.418	120	9
Neuheisel, UCLA	19.27	2	81	Ferentz, Iowa	0.437	119	17
Miles, LSU	17.68	3	37	Petersen, Boise State	0.451	118	13
Saban, Alabama	9.51	4	6	Patterson, TCU	0.457	117	10
Kiffin, Tennessee	9.20	5	55	Parrish, Ball State	0.540	116	35
Sherman, Texas A&M	8.61	6	87	Calhoun, Air Force	0.566	115	51
Richt, Georgia	7.87	7	16	Gundy, Oklahoma State	0.594	114	12
Rodriguez, Michigan	7.18	8	84	Graham, Tulsa	0.624	113	30
Davis, North Carolina	6.93	9	27	Spaziani, Boston College	0.632	112	33
Mullen, Mississippi State	5.57	10	86	Ault, Nevada	0.633	111	52
2010							
Meyer, Florida	15.77	1	2	Petersen, Boise State	0.259	120	11
Stoops, B., Oklahoma	13.83	2	12	Patterson, TCU	0.310	119	5
Kiffin, Southern Cal	8.77	3	25	Jones, Cincinnati	0.423	118	8
Neuheisel, UCLA	8.14	4	50	Beamer, Virginia Tech	0.546	117	4
Rodriguez, Michigan	7.23	5	70	Johnson, Georgia Tech	0.566	116	10
Fisher, Florida State	6.28	6	40	Riley, Oregon State	0.646	115	28
Brown, Texas	6.11	7	3	Enos, Central Michigan	0.654	114	46
Sarkisian, Washington	6.05	8	52	Calhoun, Air Force	0.661	113	37
Chizik, Auburn	5.76	9	22	McNeill, East Carolina	0.662	112	53
Miles, LSU	4.29	10	15	Edsall, UConn	0.679	111	31
2011							
Fisher, Florida State	25.59	1	12	Petersen, Boise State	0.275	120	4
Brown, Mack	25.19	2	57	Ault, Nevada	0.325	119	18

(continued)

Table 5. (continued)

	Top 10			Bottom 10			
2009	Ratio	Recruiting Efficiency	Ex ante SRS		Ratio	Recruiting Efficiency	Ex ante SRS
Richt, Georgia	11.20	3	39	O'Brien, NC State	0.475	118	20
Kiffin, Southern California	9.48	4	24	Calhoun, Air Force	0.558	117	37
Chizik, Auburn	7.94	5	3	Niumatalolo, Navy	0.618	116	48
Dooley, Tennessee	7.02	6	56	Long, SDSU	0.634	115	40
Tuberville, TexasTech	4.88	7	49	McMackin, Hawaii	0.642	114	38
Nutt, Mississippi	4.34	8	69	Pinkel, Misouri	0.667	113	15
Kelly, Notre Dame	4.26	9	21	Stoops, M., Arizona	0.673	112	31
Fickell/Tressel, Ohio State	3.80	10	7	Erickson, Arizona State	0.681	111	28

Note. SRS = simple ranking system.

estimated; one that predicts the likelihood of a dismissal and another that predicts the time to a quit for coaches moving to another position. The empirical models for each case are shown below. The variable definitions are as they were in the previous models. The new variables $TALENTEFFCIENCY_{kt}$ and $RECRUITINGEFFICIENCY_{kt}$ are the efficiency estimates constructed for each coach-year observation from Equations 2 and 4, respectively. The variable $WINPERFORMANCE_{kt}$ is entered under three possible configurations. These are annual measures of overall win percentage, conference win percentage, and SRS rank.

$$\begin{aligned} FIRED = {} & \alpha TERM_{kt} + \beta_0 + \beta_1\ BCS + \beta_2\ AGE + \beta_3\ ADVDEGREE_{kt} + \beta_4\ RACE_{kt} \\ & + \beta_5 TALENTEFFICIENCY_{kt} + \beta_6 RECRUITINGEFFICIENCY_{kt} \\ & + \beta_7 WINPERFORMANCE_{kt}. \end{aligned} \tag{4}$$

$$\begin{aligned} MOVED = {} & \alpha TERM_{kt} + \beta_0 + \beta_1\ BCS + \beta_2\ AGE + \beta_4\ ADVDEGREE_{kt} \\ & + \beta_5\ RACE_{kt} + \beta_6\ TALENTEFFICIENCY_{kt} \\ & + \beta_7\ RECRUITINGEFFICIENCY_{kt} + \beta_8 WINPERFORMANCE_{kt}. \end{aligned} \tag{5}$$

The results shown in Tables 6 and 7 confirm that lower levels of both measures of efficiency and win performance increase the probability that the coach will be fired at the end of the current season. Additionally, the longer the term of employment with his current team, the more likely a coach will be fired after (or during) the current season.

For coaches who move on to another position, higher levels talent use efficiency and winning are the primary motivating factors, but recruiting efficiency is not relevant. Older coaches are less likely to move, and job quality matters, as are coaches currently employed by a school in a BCS conference are more likely to stay.

The final model evaluates the effect of making a coaching change on team performance. Evaluation of the determinants of the annual change in the SRS rank, which represents the dependent variable in Equation 8, exposes whether succession is a good choice for a struggling program.

$$\begin{aligned} DSRSRANK = {} & \alpha TERM_{kt} + \beta_0 + \beta_1 BCS + \beta_2 AGE + \beta_4 ADVDEGREE_{kt} \\ & + \beta_5 RACE_{kt} + \beta_6 TALENTEFFICIENCY_{kt} \\ & + \beta_7 RECRUITINGEFFICIENCY_{kt} + e_{it}. \end{aligned} \tag{6}$$

The models are again estimated by a negative binomial—fixed-effects regression. To evaluate the effect of replacing a coach, the sample is divided into first-year and veteran-coach subgroups.

The regression results are reported in Table 8. Table 9 reports the 15 best and 15 worst talent use efficiency rankings of the first-year coaches. For experienced coaches, higher levels of both measures of efficiency are significant determinants of

Table 6. Survival Analysis: Employment Spells to Dismissal.

	Dependent variable: Fired					
	706		686		706	
Subjects	87		85		87	
Fires	Hazard ratio	z	Hazard ratio	z	Hazard ratio	z
BCS	1.216	0.67	1.014	0.05	1.254	0.59
AGE	−0.991	−0.56	−0.992	−0.51	−0.992	−0.53
ADVDEGREE	−0.631*	−1.86	−0.633*	−1.80	−0.623*	−1.89
RACE	−0.797	−0.65	−0.871	−0.40	−0.818	−0.58
TERM	1.043**	2.24	1.046**	2.34	1.037*	1.98
W-L %	−0.153***	−2.40				
CONFERENCE W-L %			−0.200	−2.52		
SRS					−0.972	−1.31
TALENT USE EFFCIENCY	−0.219***	−3.37	−0.221***	−3.48	−0.165	−3.98
RECRUITING EFFICIENCY	−0.761	−2.46***	−0.745***	−2.61	−0.744	−2.62
/ln_p	7.278***	88.95	7.277***	87.47	7.275	88.51
p	1,447.72		1,447.207		1,443.949	
1/p	.001		.000691		.001	
		$p > \chi^2$		$p > \chi^2$		$p > \chi^2$
Log Likelihood	360.61***	.00	374.26	.00	358.59	.00

Note. SRS = simple ranking system.
*Significant at .1. ** Significant at .05. ***Significant at .01.

improved rankings. However, for first year coaches, only talent use efficiency matters. In most cases, the first year coaches with the highest efficiency ranks remain at their jobs, or like Brian Kelly, who moved from the University of Cincinnati to the University of Notre Dame, they have moved up to a better job. In almost all of the fast starter situations, the new coach replaced either a retired coach or a successful coach who had moved on. It is fair to say that they used the available talent well, but also it is likely that they benefited from decent levels of talent left behind by the predecessor. The first year coaches who made the least efficient use of the available talent have been fired or are likely to be dismissed soon. In almost all of these cases, the new coach replaced a coach who was fired, but it is not necessarily the case that they inherited a dearth of talent. A hornets' nest of external factors may also provide a more suitable explanation. Nevertheless from the group of slow starters, only Tom O'Brien at North Carolina State went on to amass a significant tenure. Like Derek Dooley of Tennessee, O'Brien was fired after the 2012 season.

Summary

The results show that efficiency of both input use and input accumulation are important determinants of the coach's performance. The employment decision to replace

Table 7. Survival Analysis: Employment Spells to Quit.

	Dependent variable: Moved					
Subjects	706		686		706	
Moved	35		34		35	
t	Hazard ratio	z	Hazard ratio	z	Hazard ratio	z
BCS	0.416*	2.20	0.514*	1.67	0.356	2.35
AGE	0.942*	2.09	0.941*	2.11	0.938	2.24
ADVDEGREE	0.762	−0.72	0.773	−0.69	0.818	−0.54
RACE	0.527	−1.01	0.538	−0.98	0.503	−1.08
TERM	1.039	0.86	1.040	0.89	1.049	1.06
W-L %	9.187***	2.39				
CONFERENCE W-L %			5.677***	2.31		
SRS					1.033	1.43
TALENT USE EFFICIENCY	1.072***	2.82	1.081***	3.44	1.081	3.06
RECRUITING EFFICIENCY	0.998	−0.02	1.004	0.06	1.000	0.0000
/ln_*p*	7.256***	55.3	7.281***	54.95	7.260***	55.37
p	1,416.56		1,453.02		1,421.79	
1/*p*	.001		.001		.001	
Log likelihood	110.77871	.0001	108.670	.0001	108.760	.0005

Note. SRS = simple ranking system.
*Significant at .05. **Significant at .1. ***Significant at .01.

Table 8. Year-to-Year Performance Changes.

	Dependent variable:					
DSRS RANK	All Coefficient	z	Experienced Coefficient	z	First Year Coefficient	z
CONSTANT	2.917	18.99	3.014	16.6	3.053	3.07
BCS	−0.131	−1.01	0.090	0.64	−0.562	−0.89
AGE	0.001	0.58	−0.002	−0.56	0.002	0.29
ADVDEGREE	0.021	0.59	0.001	0.02	−0.017	−0.11
RACE	0.003	0.07	−0.048	−0.82	0.049	0.29
TERM	0.008***	1.95	0.010***	2.07	—	—
TALENT USE EFFICIENCY	−0.046	−4.29	−0.033	−4.16	−0.167	−2.24
RECRUITING EFFICIENCY	−0.020	−4.18	−0.018	−4.13	−0.074	−1.31
Log likelihood	−2,626.72	0.00	−2,061.46	0.00	−120.68	0.443

*Significant at.01. **Significant at .05. ***Significant at .1.

coaches who are deficient in these areas is a wise choice, as a football program's performance on average does improve after a dismissal. Notwithstanding, there are some shortcomings of the study. A coach's recruiting strategy may reflect a style of

Table 9. First Year Coaches' Talent: Use Efficiency Rankings.

Year	Coach/Team	Efficiency Ratio	Efficiency Rank	Hire Condition	Term	Result[a]
15 Best First-Year Efficiency Ranks						
2006	Petersen, Boise State	8.136	3	Moved	7+	Incumbent
2007	Kelly, Cincinnati	6.378	5	Moved	2	Moved
2011	Shaw, Stanford	5.408	4	Moved	2+	Incumbent
2009	Kelly, Oregon	5.291	7	Retired	4	Moved
2011	Doeren, Northern Illinois	3.289	12	Moved	2	Moved
2007	Erickson, Arizona State	3.192	8	Fired	5	Fired
2008	Niumatalolo, Navy	2.678	15	Moved	5+	Incumbent
2011	Franklin, Vanderbilt	2.616	16	Fired	2+	Incumbent
2011	Addazio, Temple	2.612	17	Moved	2	Moved
2007	Calhoun, Air Force	2.514	13	Retired	6+	Incumbent
2011	Blankenship, Tulsa	2.443	19	Moved	2+	Incumbent
2006	Bielema, Wisconsin	2.441	13	Retired	7	Moved
2007	Jagodzinski, Boston College	2.297	16	Moved	2	Fired[b]
2008	Nutt, Mississippi	2.254	19	Fired	4	Fired
2011	Hoke, Michigan	2.105	21	Fired	2+	Incumbent
15 Worst first year efficiency ranks						
2008	Rodriguez, Michigan	0.106	120	Retired	3	Fired
2007	Shannon, Miami, Florida	0.177	117	Fired	4	Fired
2008	Sherman, Texas A&M	0.246	119	Fired	4	Fired
2011	Fickell, Ohio State	0.273	119	Fired[b]	1	Fired
2010	Kiffin, Southern California	0.290	117	Moved	3+	Incumbent
2008	Neuheisel, UCLA	0.318	114	Fired	4	Fired
2007	Davis, North Carolina	0.339	113	Fired	4	Fired[b]
2010	Dooley, Tennessee	0.357	115	Fired	3	Fired
2011	Muschamp, Florida	0.447	115	Moved	2+	Incumbent
2007	O'Brien, North Carolina State	0.462	109	Fired	7	Fired
2008	Wulff, Washington State	0.470	111	Fired	4	Fired
2006	Hawkins, Colorado	0.470	100	Fired	5	Fired
2011	Graham, Pittsburgh	0.477	114	Fired	1	Moved
2011	Edsall, Maryland	0.491	113	Fired	2+	Incumbent
2011	Withers, North Carolina	0.495	112	Fired[b]	1	Fired

[a] As of August 2013. [b] Fired for insubordination not performance.

play, and coaches who employ a nontraditional style may be less interested in obtaining those players who are rated highly by the recruit ranking services. The method employed here undervalues these coaches in recruiting efficiency and consequently overvalues their talent use efficiency. The example of Rich Rodriguez, who moved from West Virginia University to the University of Michigan in 2008, underscores this issue. Rodriguez in just one season went from the highest ranked coach in talent use efficiency at WVU to dead last at Michigan, and he did not escape the bottom 10 in talent use during his short 3-year tenure with the Wolverines. It is not likely his coaching skills quickly degenerated or that he was a flagrant shirker, but that the talent on hand, and even that which he recruited at Michigan, did not fit well with style of play he used successfully at West Virginia.

Additionally, there seems to be great opportunities for more and better research in this area. This study and the data collected are not adequate for evaluating some of the most pertinent coaching human capital and succession issues. More analysis should examine the effectiveness of internal versus external succession. Those effects were tested, but the available data are not sufficient for a proper evaluation. Second, a more detailed look at coaches' human capital may be instructive. For example, answers to the following questions may be interesting: Does NFL experience benefit a college head coach? Is experience as a coordinator at a high level more valuable than head coaching experience at lower level schools? Does the coach's playing experience matter, and if so at what position? Last, data are becoming increasingly available on coaches' salaries, bonuses, and other contract terms. With that come many opportunities to examine performance relative to incentives and compensation.

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Notes

1. The values of broadcast rights for college football games in the high-resource conferences (see footnote #2) have increased 10-fold in value since the mid-2000s.
2. The high-resource group includes the 64 members (as of 2013) of the ACC, Big 10, Big 12, PAC 12, and SEC conferences. As of 2013, the annual payments to high-resource conferences for TV broadcast rights alone averaged nearly US$20 million per school. This amount exceeds the entire athletic department budgets for their less endowed counterparts at the lower reaches of the Football Bowl Subdivision (FBS).
3. Florida's hire of Texas assistant Will Muschamp's in 2011 and Penn State's hire of Jim O'Brien, an assistant with the NFL New England Patriots in 2012 are examples of each, respectively.
4. For example, Michigan enticed Rich Rodriguez to transfer jobs from West Virginia, LSU brought Les Miles over from Oklahoma State, and Auburn coaxed Gene Chizak from Iowa State.
5. The adjustments for margin of victory are as follows: 3 points are added to the visiting team's score for each game. All wins and losses between 7 and 24 points are entered as exactly such. Wins and losses of 0 to 6 points are scored as 7-point wins and losses.

To avoid giving undue credit to teams that run up the score wins of more than 24 points/losses of more than 24 points are scored as the average between the actual number and 24 (Stuart, 2011).

6. The ratings of specific high school players and the methods for the calculating the cumulative score assigned to each school's recruiting class are similar but vary across each of the services. The result is some differences in the exact rank order of each service in a given year. However, the correlation coefficients across these ranks are well in excess of 0.9, and we are confident that Rivals provides an accurate assessment for our purposes.
7. The new coach may well use some talent from his predecessor through 5 years. However, only the years to show that the effect dissipates each year to the point where its influence on the coach's performance is not statistically significant are included.
8. The full ranking table for all coaches is included in the appendix available at https://docs.google.com/file/d/0B1ajCitVBkfFWWQyLTh3NnFvVXM/edit
9. The author acknowledges identification between Equations 2 and 4 is a potential concern as the respective dependent variables STS_{it} and $CLASSRANK_{it}$ influence each other with some lag structure. Notwithstanding, determination of an appropriate instrument of identification is very ambiguous and problematic.
10. Also considered were the effects of National Collegiate Athletic Association's sanctions that reduced the number of permitted scholarships, on the quality of the recruiting class. However, the probability that the effect variable was equal to zero was so high that the variable was not included in the final model specifications.

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Author Biography

Joel G. Maxcy who has written extensively on the economics of the sports industry, is an economist and associate professor in the School of Tourism and Hospitality Management at Temple University. He believes that those who can't play, coach and those who can't coach . . . teach sports economics.